BALD EAGLE CROSS-CUT CANAL LOCK
(West Branch Pennsylvania Canal, Lock No. 35)
North of Water Street along West Branch Susquehanna
River south bank, 500 feet east of Jay Street Bridge
Lock Haven
Clinton County
Pennsylvania

HAER No. PA-187

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
Northeast Field Area
Chesapeake/Allegheny System Support Office
National Park Service
U.S. Custom House
200 Chestnut Street
Philadelphia, PA 19106

HAER
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HISTORIC AMERICAN ENGINEERING RECORD

BALD EAGLE CROSS-CUT CANAL LOCK HAER No. PA-187
(West Branch Pennsylvania Canal, Lock No. 35)

Location: Located on the north side of East Water Street, approximately 500 feet east of the Jay Street Bridge, Lock Haven, Clinton County, Pennsylvania

UTM: 18.295090.4556740
Quad: Lock Haven, Pennsylvania

Date of Construction: Ca. 1834. Altered 1873-1874

Present Owner: City of Lock Haven, Pennsylvania

Present Use: Vacant.

Significance: Lock No. 35 is a historically significant remnant of the Pennsylvania state-built canal system. The lock is the sole surviving structure of the Bald Eagle Cross-Cut Canal, a lateral line constructed off of the larger West Branch Pennsylvania Canal. The lock is often referred to as the Bald Eagle Cross-Cut Canal outlet lock as well as Lock No. 35 of the West Branch Pennsylvania Canal. Man-made waterways did much to economically develop the valley of the West Branch of the Susquehanna River from 1834 to 1889 by linking the valley with larger markets to the east. The system also turned Lock Haven into a center for transporting, processing, and distributing agricultural products, iron and coal, and lumber.

Lock No. 35 was one of nineteen locks built within the West Branch Pennsylvania Canal system in the 1830s and 1840s. Each lock employed the same materials and conformed to the same dimensions. No. 35 was unique, however, in that it was specially designed to resist floodwaters entering from the river. Reversed gates and higher head walls caused the floodwaters to work with the lock, instead of against it, thus saving the lock and the canal from permanent damage. In the 1870s, the West Branch valley waterways were reworked by the Pennsylvania Canal Company. No. 35 survives as a good example of the 1830s and 1870s periods of lock construction in the West Branch valley, based on evidence uncovered during recent excavations. Other locks in the West Branch system have survived, some in worse condition, others in better condition. What sets No. 35 apart is its unique flood-resistant design.

Project Information: Documentation was undertaken in October of 1991 and in March and October of 1992 in accordance with a Memorandum of Agreement between the U.S. Army Corps of Engineers, Baltimore District, the Advisory Council on Historic Preservation, the Pennsylvania Historical and Museum Commission, and the Lock Haven Area Flood Protection Authority. The documentation serves as a mitigative

measure for the treatment of historic properties that were identified and evaluated in a series of studies and that would be affected by the proposed Lock Haven flood protection project. The lower section of the resource documented in this report will be demolished for the construction of a flood-protection levee. Documentation was prepared for the U.S. Army Corps of Engineers, Baltimore District, by the Historic Preservation Group of Kise Franks & Straw, Inc., Philadelphia, Pennsylvania: M. Todd Cleveland, project manager; Susan C. Nabors, historian; Martin B. Abbot, historian; and Jill Cremer, graphics. Robert Tucher took the documentary photographs. Steve Humphrey, Lance Metz, Charles Derr, and Robert Goodyear of Hugh Moore Historical Park and Museums, Easton, Pennsylvania, served as the project canal experts and undertook much of the research and writing for this HAER report.

I. HISTORICAL NARRATIVE

The West Branch system was constructed between 1828 and 1837 as part of the Pennsylvania Canal system.[1] The primary purpose of the Pennsylvania Canal system was the construction of a transportation link between Philadelphia and Pittsburgh, but in order to win legislature support for this project, supporters of the Philadelphia to Pittsburgh line, or "Main Line" Canal, were forced to endorse the construction of lateral canals in the Susquehanna Valley.[2] One of the most important of these lateral canals was the West Branch system, which was conceived of as a means of linking the growing communities of the valley of the West Branch of the Susquehanna River (in north central Pennsylvania) with the more populous eastern parts of the state. It was also viewed as a possible alternate route to the Ohio Valley if a connection from it to the Allegheny River could be engineered and built.[3]

Construction of the West Branch Pennsylvania Canal began in 1827. When completed, the waterway was seventy-three miles in length. Its eastern terminus was Northumberland, where it joined with the Susquehanna Division Canal. Little work was done on the West Branch until 1831, when J. D. Harris was appointed as its principal engineer. He was assisted by Robert Faries and William D. Foster. The superintendent of the canal's construction force was William P. Packer, a Williamsport newspaper editor and future governor of Pennsylvania.[4] The construction of the West Branch system was divided into two sections: the "Muncy Line", which was composed of the first twenty-four miles north and west of Northumberland, and the combined Upper and Lower "Lycoming Lines", which would eventually extend to Lock Haven.[5] As originally designed, the West Branch Pennsylvania Canal would utilize nineteen locks to overcome 138-1/2 feet in elevation difference between its terminal points, while each lock itself would be ninety feet in length and seventeen feet in width.[6] A more detailed description of the locks of the West Branch system is contained in the following contract for the construction of a lock on the Lycoming Line.

> The chambers of the locks are to be 90 feet from quoin to quoin by 17 feet in width, the bottom to be laid with foot timbers 2 feet from centre to centre -- on the bottom timbers is to be laid a course of two inch plank throughout their length upon the side walls are to be started and immediately in front of side walls are to be fastened sills extending from the lower hollow quoin to the head of the lock . . . The mason work to be laid dry with large-size stone, the tail of the lock from the lower hollow quoin to be laid in courses of hammer dressed stone.[7]

Contracts for the construction of the Lycoming Line of the West Branch Pennsylvania Canal from Muncy Dam to Bald Eagle Creek were let on July 1 and August 24, 1831.[8] Funding shortages delayed construction of the Lycoming Line until January of 1833, when the Pennsylvania Canal Commissioners ordered that the engineer of the Upper Division of the Lycoming Line should make a survey and an estimate of the expense of connecting the Lycoming Line with the Bald Eagle Creek at its mouth, as well as at a point above Great Island.[9] In response to this order, James D. Harris made the required surveys and estimates, and by April, he submitted his report to Canal Commissioners John Mitchell and Josiah White, who were inspecting the valley of the West Branch of the Susquehanna River.[10]

The need for the construction of a connection between the West Branch system and the Bald Eagle Creek was brought about by the formation of the Bald Eagle and Spring Creek Navigation

Company, which was authorized by the Pennsylvania legislature to construct a canal from Bellefonte in Centre County to the West Branch of the Susquehanna River.[11] To finance this waterway, the Pennsylvania legislature guaranteed the 5% annual interest on the company's stock issue, which was not to exceed $200,000.

The Bald Eagle and Spring Creek Navigation generally followed the routes of Spring and Bald Eagle Creeks. Beginning in Bellefonte, the navigation system followed Spring Creek until it merged with the large Bald Eagle Creek at Milesburg. As designed by engineer M. R. Stealey, the Bald Eagle and Spring Creek Navigation was built in two sections that joined at Howard Furnace. The Lower Division, which stretched for 12-1/2 miles from Howard Furnace to Lock Haven, was completed in 1837, while the Upper Division, which stretched for 12-1/2 miles from Howard Furnace to Bellefonte, was not opened until 1848.[12] The Bald Eagle and Spring Creek Navigation soon developed into a major transportation route for pig iron and bituminous coal.

As designed by James Harris, the connection between the Bald Eagle and Spring Creek Navigation and the West Branch Pennsylvania Canal took the form of a cross-cut canal. From Williamsport to a point opposite the community of Lock Haven, the Lycoming Line of the West Branch system ascended the east bank of the West Branch of the Susquehanna. At what was the infant community of Lockport (now Lower Lockport), opposite Lock Haven, Lock No. 34 (see HAER No. PA-188) was built to allow canal boats to enter a slack water pool that was formed behind the Bald Eagle Dam across the West Branch of the Susquehanna River. The boats then crossed to the opposite shore by means of a cable ferry to enter Lock No. 35 at the Bald Eagle Cross-Cut Canal.[13] It should be noted that the primary purpose of Bald Eagle Dam was to supply water for the Lycoming Line of the West Branch Pennsylvania Canal.

The Bald Eagle Cross-Cut Canal was almost four miles in length, including the width of the crossing of the slack water pool. The total cost of the Bald Eagle Cross-Cut Canal was $47,850.01 when completed in 1834. The West Branch Pennsylvania Canal, whose prism, or cross section, was twenty-eight feet wide at the bottom and contained a depth of four feet of water, became the model for the construction of the Bald Eagle Cross-Cut Canal.[14]

The locks of the Bald Eagle Cross-Cut Canal were also identical in dimension to the locks of the West Branch system, being ninety feet long and seventeen feet wide. Lock No. 35, which was the outlet lock between the Bald Eagle Cross-Cut Canal and the slack water section of the West Branch system, was designed with eight feet of lift. It was described in greater detail by James D. Harris in 1833:

> The lockage from the bottom of the canal of the Bald Eagle Side Cut to the bottom of canal of the feeder is eight feet, which is overcome by one lock at the pool of the feeder dam. A pair of reversed gates is attached to the head of this lock to guard against the influx of water from the river at a time of high floods, answering all of the purposes of a guard-lock. The walls at the head of the lock are raised five feet higher than usual in a lift lock. No other lock is required on the side-cut except a guard lock at the Bald Eagle (Creek) which is being built of wood.[15]

Work on both the Lycoming Line of the West Branch system at Lock Haven and the Bald Eagle Cross-Cut Canal progressed from 1833 until completion in the autumn of 1834.[16] With the completion of the Upper Division of the Bald Eagle and Spring Creek Navigation in 1837, a

considerable volume of iron and bituminous coal began to pass through the Bald Eagle Cross-Cut and enter the West Branch system. The West Branch itself became a prosperous waterway. By 1847, over 572 boats utilized the port of Lock Haven, which developed an extensive commercial district along the present Water Street to serve this waterborne traffic.[17]

Because the entire Pennsylvania state-built canal system produced insufficient revenue to cover operating expenses, repair costs, and the interest on the bonds that had been issued to pay for the canals construction, in 1857 Pennsylvania decided to dispose of its state-built canal system. The Pennsylvania Main Line Canal was sold to the Pennsylvania Railroad, and the other parts of the system were transferred to the Sunbury and Erie Railroad. This transaction was designed to aid the Sunbury and Erie Railroad in its struggle to complete its line. The Sunbury and Erie Railroad sold the Bald Eagle Cross-Cut, West Branch and Susquehanna Division canals to the newly-formed West Branch and Susquehanna Canal Company.[18]

While the Bald Eagle Cross-Cut, West Branch, and Susquehanna Division canals remained viable operations under the management of the new company, the Bald Eagle and Spring Creek Navigation System began to suffer competition from railroads that were built during the 1850s along its route. The final blow came in 1865 when a serious flood almost completely destroyed this waterway, and it was abandoned.[19]

Railroad competition also affected the canals at Lock Haven. The arrival of the Philadelphia and Erie Railroad, the successor to the Sunbury and Erie Railroad, at Lock Haven in 1859 began a process by which the business district of the community was relocated from Water Street inland to the railroad's line along the present Main and Church Streets.[20]

In 1867, the Bald Eagle Cross-Cut, West Branch and Susquehanna Division canals were sold to the Pennsylvania Railroad, which organized the Pennsylvania Canal Company to manage these waterways and its other canal properties.[21] Believing that the canals of the Susquehanna River Valley could effectively serve as transportation systems for bulk commodities such as coal, iron, and stone, the Pennsylvania Canal Company upgraded its waterways by widening and deepening them as well as doubling the length of their locks.[22] These improvements were undertaken during 1873-1874, resulting in the passage of canal boats that could carry up to 260 tons of cargo if joined together in pairs. Many of these upgraded boats were built during the next five years. Lock No. 34 of the West Branch Pennsylvania Canal (see HAER No. PA-188) is a good surviving example of one of the enlarged Pennsylvania Canal Company lift locks. Despite improvements by the Pennsylvania Canal Company, traffic did not increase on the Bald Eagle Cross-Cut, West Branch and Susquehanna Division canals. In 1864, some 1,077,930 tons of cargo passed through the waterways; in 1878, the annual total had fallen to 668,707 tons.[23]

In 1889, the Bald Eagle Cross-Cut and Lycoming Line of the West Branch system were severely damaged by a flood and were abandoned by the Pennsylvania Canal Company. All navigation ceased west of Loyalsock. Interestingly, Lock No. 35 survived the flood because of its flood-resistant design. On November 5, 1889, a portion of the Bald Eagle Cross-Cut was sold to the Philadelphia and Erie Railroad for $75,000.[24] This property passed into the control of the Pennsylvania Railroad when that company absorbed the Philadelphia and Erie Railroad in 1907.[25] In 1914, the Pennsylvania Railroad sold the property to Charles Kiger. For most of the rest of this century, the site has been under the control of the city of Lock Haven. Between 1915-1920, the remains of the Bald Eagle Cross-Cut Canal were filled in with trash and debris

and the area developed as a park.[26] In addition, a storm sewer was placed within Lock No. 35, running parallel to the lock, in the early part of the century. A small portion of the Bald Eagle Cross-Cut Canal remains open and is used as a water source by the Hammermill Paper Company at Lock Haven.[27]

II. PHYSICAL DESCRIPTION

Lock No. 35 of the West Branch Pennsylvania Canal, which also functioned as the outlet lock for the Bald Eagle Cross-Cut Canal, was constructed at the southern side of the Susquehanna River's West Branch in an area which became known as Lock Haven. In fact, the lock and the town were developed at roughly the same time. As constructed, the lock was ninety feet in length and seventeen feet wide, with eight feet of lift. ("Lift" refers to a process whereby a boat enters a lock, the upper and lower gates are closed, and an amount of water is released into the lock (or drained from it) to lift (or lower) the boat a certain number of feet--in this instance, eight feet--thus placing the boat at either the upper or lower water level.) Within the lock, dry-laid stone was used for the walls and dressed stone for the tail. The flooring was constructed of two-inch planks atop rough timbers. This design using stone and wood was typical for its period, as the use of all-wood lift locks had been discontinued by about 1830. Wooden lift locks, although inexpensive to build, tended to have a short life span. This was due to the rot that infected the wooden members from the constant wetting and drying action as the water level within the lock rose and fell. In the stone and wood design, the wooden members remained underwater at all times and, thus, did not experience rot. All-wood guard locks continued to be built because they sat completely under the water. One of these guard locks was constructed at the west end of the Bald Eagle Cross-Cut Canal. This lock is no longer extant.

Lock No. 35 was a unique lock among those of the West Branch system. Because of its location at the edge of the river, it was specially designed to resist the damaging effects of floodwaters entering from the river. By installing reversed gates and adding five feet of height to the walls at the head of the lock (to increase water-holding capacity), its designers hoped to create a situation whereby floodwaters would work with the lock, instead of against it, thus saving the lock and the canal from permanent damage. The lock functioned, then, not only as a lift lock but also as a guard lock, i.e., it guarded the canal from damage caused by the influx of floodwaters from the river by use of its reversed gates and higher head walls. The lock also operated as an outlet lock, in that it was the point where the water flow of the canal emptied into the river and where boats traveling toward the east would leave the canal to go out into the river. The system of canals in the area operated as designed until the great flood of 1889 totally destroyed the Bald Eagle Cross-Cut Canal along with the other canal systems in the valley. Lock No. 35 survived, however, because of its special flood-resistant design.

Presently, the north end walls of the lock are partially visible, protruding from the river bank approximately 500 feet east of the Jay Street Bridge. The walls are approximately fifteen feet and ten inches apart where they run parallel to one another and approximately forty-five feet apart at the extreme northern end where they flare out at roughly forty-five-degree angles. From the northern ends to where the walls disappear into the riverbank, the walls measure approximately twenty-seven feet. The bank supports Water Street, which runs along the river. Several iron clamps are still in place along the walls, holding the topmost row of stones, or capstones, together. The protruding wall sections exist in a park setting and are surrounded by large trees,

benches, and decorative lamp posts. A historical marker provides a brief description of the canal and its role in Lock Haven's history.

Lock No. 35 is relatively intact, at least at the northern end, which was uncovered during excavations on October 30, 1991, March 2-5, 1992, and October 13-15, 1992. Working within the footprint of the levee planned for that location, the October 1991 excavations exposed an area of the east lock wall to a depth of approximately fourteen feet. The wall appeared to be in sound condition, due to the presence of fill that for many years has prevented the normal effects of the freeze/thaw cycle. No evidence of the reversed gates, the associated hydraulic mechanisms, or the sill was found, nor were any of the flooring planks and cross timbers discovered. It was surmised by the archaeologists and the canal expert on hand that the gates, mechanisms, and sill were located further south of the project area, beneath or beyond present-day Water Street (if the features were indeed still extant). Physical evidence supported this view, in that the east wall surface was smooth and showed no sign of scars, indentations, or pockets that would have held the gates. Historical evidence supplied by drawings and maps of the lock is inconclusive. Though the drawings and maps depict the gates as lying in the area of Water Street, the location of the street has changed over time, and the changes have not been well documented.

The March 1992 excavations, again working within the footprint of the levee planned for that location, sought to find evidence of the flooring that had not been found during the October work. After several days of pumping out the water that continued to flood the excavation area, and after repair of the early-twentieth-century storm sewer line that had previously ruptured and whose presence served to limit the available area of excavation, the wooden flooring of the lock was found. Within an eight-foot-square area, two layers of 2x6x10 to 2x6x12 planks were uncovered, running parallel to the lock walls and attached to underlying cross timbers with iron spikes and wooden pegs. The cross timbers were approximately twelve inches in diameter and were planed on the top and bottom edges. The masonry west wall was constructed on top of the cross timbers and the bottom layer of planking. This configuration is in accordance with the historical description of the locks of the West Branch Pennsylvania Canal (see Section I., "Historical Narrative") and was confirmed by the canal expert as being typical of locks along the West Branch system. The masonry wall measured fourteen feet and ten inches in height; the additional wooden flooring at the bottom added roughly another foot, for a total height of approximately fifteen feet and ten inches of man-made construction. It had been hypothesized by consultants undertaking earlier studies that perhaps the lock was deepened in the 1870s as part of the Pennsylvania Canal Company's reworking of the canals in the West Branch Valley. Upon the uncovering of the west wall profile down to the level of the flooring, it was discovered that the wall had a uniform appearance and showed no sign of alteration. Therefore, it was surmised by the canal expert that the lock was never deepened and, thus, exhibited its original 1830s construction. It should be noted that no evidence of the reversed gates, hydraulic features, or sill was found during the March work along the west wall; this gives further credence to the belief of the archaeologists and the canal expert that these features, if still extant, lie to the south of the project area, beneath or beyond Water Street.

Also during the March 1992 excavations, an exploratory trench was dug along the outer side of the east lock wall to a depth of approximately five feet, in order to examine the construction of the masonry lock walls from the rear perspective. It was discovered that each lock wall actually consists of two eighteen-inch-thick walls of stone beneath a finished capstone of thirty-six inches' width. A finished wall of smooth-cut stones faces into the lock, while a wall of rough-

cut stones is located to the rear, facing into the hillside. Between the rough-cut stones and the soil of the hillside is an area of infill, consisting of cobblestones and pieces of shale.

Unlike the two previous excavations, which were located within the area of effect created by the construction of the flood protection levee, the October 1992 excavations were directed south of the previous work, within an extension of the area of effect that contained an area of sewer line construction. Based on documentary evidence and an exploratory excavation monitored by the Clinton County Historical Society in the summer of 1992, it was believed that the third excavation would reveal evidence of the lower end lock gate recesses, the lower end sill, and, perhaps, associated gate mechanisms and hardware. It was not assumed that the reversed gates and their associated mechanisms would be discovered, however. Through documentary evidence and on-site observation, it was determined that the reversed gates are located at the south, or upper, end of the lock, outside of the area of effect. (The terms "upper" and "lower" correspond to the upstream and downstream ends of the lock.) Thus, the reversed gates, should they still exist, will not be disturbed as part of the flood-protection construction work.

The purpose of the third round of excavations was to find evidence of the above-mentioned lock features so as to add to the body of knowledge concerning the lock and supplement the HAER documentation prepared subsequent to the first two excavations. The overall area of excavation extended from the middle of Water Street to a point approximately forty-two feet to the north. In an east-west direction, the area of excavation extended some seventeen feet to each side of the lock walls, for a total distance of approximately fifty feet. At its northern end, the area of excavation extended into the earlier excavation areas by some six feet. On the east side of the east lock wall, the fill was removed, revealing the rear side of the wall. (The configuration of the lock walls, as seen from the rear side, was documented as part of the March 1992 excavations.) Within the lock walls, the fill was removed to the sill level of the lower end gate recesses. To the north and south of the recess area, the grade was sloped up at an approximately one-to-one ratio. The slopes were necessary so as to provide a safe work environment for the excavation team, in conformance with OSHA standards.

During the course of the excavation, the following lock elements were discovered: the east and west lower end gate recesses, the lock walls north and south of the recesses, fragments associated with the east and west gates, the gate sill, and remnants of the east side bridge abutment. The plank and crossbeam flooring of the lock was not documented during the third round of excavations, as this feature was documented earlier during the March 1992 excavations.

The east and west lower end gate recesses were constructed of the same smooth-cut stone blocks as the lock walls discovered during the October 1991 and March 1992 excavations. The recesses measured 11' 6" in width, 14' 6" in height, and were recessed back from the adjacent wall surfaces 1'4". The south ends of both recesses met the adjacent wall surface at a ninety degree angle, while the north ends exhibited a curved juncture with the adjacent wall surfaces. To the south of both recesses, the wall configuration changed, as the large stone blocks remained in place at the top and bottom of each wall, while smaller infill stones were positioned in the remaining wall area between. These smaller stones were once covered with horizontal planks attached to vertical timber nailers. This arrangement extended the length of the lock on both walls in the area between the lower and upper end gates. The planks and nailers are no longer extant on the walls within the area of excavation.

The fragments associated with the lower end east and west gates were found loose in the fill between the lock walls. One fragment, the bottom horizontal beam of the east gate (measuring approximately 9" square), was found in its original location--against the east gate recess wall--still resting on the cast iron ball joint at the pivot point of the gate (north end of the recess). The 1'-diameter ball joint was positioned within the wooden socket of the beam. The beam and ball joint were removed from the lock for submission to the Clinton County Historical Society. At the miter end of the beam (the end that met with the opposite gate in the middle of the lock), there was a vertical metal rod that would have run inside one of the vertical wooden supports between the wickets, or paddles (see descriptive information below). The rod was designed to hold the vertical and horizontal members together.

It is assumed that the gate fragments found in the fill were from the east gate, as no evidence of the west gate was located during the excavation, while the bottom horizontal beam of the east gate was still in place. A portion of a horizontal gate beam with cast iron insets for wicket poles was located, which would have been the second beam up from the bottom of the gate. The cast iron was used to prevent wear on the wood from the turning of the wicket poles. Although only two cast iron insets were found, it is assumed that three insets for three wickets poles were located within each gate, due to the width of the gate (10'8"). Thus, there would have been six wickets in all across the lower end gate recess area. Two vertical supports with tenons were discovered, which would have been mortised into the bottom horizontal beam. These supports, measuring 36" high, were designed to separate the wickets, located at the bottom of the gate. Only two supports were found, although each gate would have been wide enough for four supports. Also located in the fill was part of a metal strap that would have wrapped around the gate edge to hold the vertical and horizontal members together. Finally, three wickets were discovered, each measuring 24" by 36", with their metal poles still attached. The wickets were wooden paddles that served as sluice gates within a larger gate, allowing for the intake or outtake of water from a lock as barges made their passage through the lock. The vertical arrangement across the bottom of each gate, between the bottom two horizontal members, would most likely have been as follows: heel post (at the pivot point), vertical support, wicket, vertical support, wicket, vertical support, wicket, vertical post, and miter post (at the juncture with the other gate in the middle of the canal). Various unidentifiable wood pieces and two floor planks were also found in the fill. All of the above features were removed from the lock for submission to the Clinton County Historical Society.

The only feature associated with the west gate recess area was a retaining strap, measuring 2'6" long and 1'1.5" wide, located at the pivot (north) end of the recess. The strap was attached to two 10.5"-long by 1.25"-wide plates, attached to the corner capstone by four metal bolts sealed into the stone with melted lead. The U-shaped strap was cantilevered over the recess at a forty-five degree angle. The pivot, or heel, post would have fit into the strap, with the strap then functioning as a hinge and as a support for the gate to keep it in an upright position. (A balance beam--not found for either gate--would also have supported the gate in an upright position, due to its weight cantilevered off of the gate, and would have functioned as the means for opening and closing the gate.) No retaining strap was found at the east gate recess, although scars in the capstone were located and three bolts in melted lead were still in place. The west gate retaining strap was removed from the lock for submission to the Clinton County Historical Society.

The lower end gate sill discovered during the excavation is known as a miter sill, due to the mitered edges of its members and to the miter gates that come together at a mitered point and rest against the sill. The triangular-shaped wooden sill was made up of a central north-south beam

with a notched south end, into which two beams were fitted. These beams extended to the north at forty-five degree angles, joining with another beam running east-west across the lock floor. The central notched beam also joined with the east-west beam. The spaces between the large members were covered with planks running north to south. Two of the planks were discovered loose in the fill. Because lock gates were designed to have the force of the water in the canal flow against them when closed, the gates could not be positioned so that they closed in a straight line across the lock; the water would then reverse the gates and destroy them. The triangular shape of the sill, together with the mitered edges of the gates, insured that the gates would never be reversed. In the case of the Bald Eagle Lock lower end sill, the notched arrangement provided extra protection.

The final feature associated with the lock was uncovered under the section of Water Street removed for the area of excavation. In a line with the east lock wall were the remnants of the east side bridge abutment--three large stone blocks measuring approximately 2'7" in length, 1'8" in width, and 1'8" in height, resting on fill stones. These few stones would have been part of a larger abutment supporting a wooden bridge over the lock at this location. It is assumed that the bridge and portions of the east abutment were demolished to make way for Water Street. It is known that sewer work along Water Street in 1991 resulted in the demolition of part of the east abutment. This same sewer work also removed at least nine feet of the east and west lock walls down to an unknown depth. Most likely, the lock walls continue at their original height further south beneath that portion of Water Street outside the area of effect. At the time of the 1991 sewer work, a portion of the west side bridge abutment was discovered under Water Street. An arrangement of smooth-cut large stones alternating with small stones was sighted. Because the original bridge crossed the lock in a northeast-southwest direction, the west abutment is located outside of the area of effect. It is known that the 1991 sewer work did not disturb the sighted portions of the west abutment.

III. ARCHITECTURAL, ENGINEERING AND CULTURAL SIGNIFICANCE

Lock No. 35 of the West Branch Pennsylvania Canal, constructed as the outlet lock for the Bald Eagle Cross-Cut Canal, is a historically significant remnant of the Pennsylvania state-built canal system. This structure was part of a waterway transportation system that did much to economically develop the valley of the West Branch of the Susquehanna River from 1834 to 1889. This system linked the valley with the more populated markets of Eastern Pennsylvania, including Philadelphia with its established trading ties to New York and Baltimore. The man-made water features of the region, consisting of canals, locks, and dams, together with the natural waterway of the Susquehanna River's West Branch, were responsible for the creation of Lock Haven as a commercial center. These waterways became the principal routes of commerce in the West Branch valley, and Lock Haven's position at the junction of two canal lines and at the banks of the river made it a prime trading center for the transport, processing, and distribution of agricultural products, iron and coal, and lumber. Prior to the devastating flood of 1889, Lock Haven's fortunes were almost entirely tied to the logging and lumber-processing industries. Without the river to transport the raw logs and the canals to deliver the finished lumber, this prosperity would not have been possible. The healthy economic climate generated by the waterway commerce had a ripple effect on the community; new jobs were created and new residences and commercial structures were constructed.

Lock No. 35 is relatively intact and is the sole surviving structure of the Bald Eagle Cross-Cut Canal. It is a well constructed lift lock that also served guard and outlet lock functions, and it is

typical of the locks that were built on the later branches of the Pennsylvania Canal System. Excavations at the extreme northern end of the lock on October 30, 1991, March 2-5, 1992, and October 13-15, 1992, revealed that the lock has been filled with loosely packed garbage and debris for several decades. Based on the uncovering of a portion of the east wall to a depth of approximately fourteen feet, a larger portion of the west wall to approximately sixteen feet, and the east and west lower end gate recesses to the level of the sill, the lock's masonry can be said to be in remarkably sound condition. This is due to the fill that protected the walls from being damaged by the pushing action of the freeze/thaw cycles of the earth that surrounds the lock.

Lock No. 35 was different from other locks of the West Branch system in one respect. Because of its location at the edge of a river, it was specially designed to resist the damaging effects of floodwaters entering from the river. No. 35 was built with a third set of gates that were located at the northern end and that separated the lock from the slack water pool. These gates were reversed in position to guard against the influx of floodwaters. The designers also added five feet of height to the walls at the head of the lock, thus increasing the water-holding capacity of the lock. A situation was created whereby floodwaters would work with the lock, instead of against it, thus saving the lock and the canal from permanent damage. The use of reversed gates would have been uncommon in locks built in Pennsylvania at that time and would have been considered an added expense that could only be justified by the particular need for protection at the site. With the modifications made to the standard lock design, the lock functioned as a lift and outlet lock and as a guard lock (see Section II, "Physical Description", for discussion of terms). The lock operated as designed until the flood of 1889 totally destroyed the Bald Eagle Cross-Cut Canal along with the other canal systems in the valley. Lock No. 35 survived, however, because of its special flood-resistant design.

In the late 1860s, the Pennsylvania Railroad acquired the Bald Eagle Cross-Cut Canal, the West Branch Pennsylvania Canal, and the Susquehanna Division Canal. The Pennsylvania Canal Company was founded by the railroad to operate and manage its canal interests. The company set out in the early 1870s to rework the waterways in the valley for the transport of bulk commodities, such as coal, iron, and stone. The canals were widened and deepened, and the locks, including No. 35, were doubled in length. Excavations at the lock in March and October of 1992 proved that within the area of the excavations, the lock was never deepened and that the northern end exhibits the original 1830s construction. A full profile of the west wall down to the level of the flooring and the east and west lower end gate recesses down to the level of the sill demonstrated the uniform appearance of the wall and flooring and showed no signs of alteration, thereby confirming that the lock survives in its original 1830s form within the area uncovered for the excavations.

Based on visual inspection of the east lock wall in October 1991, the west lock wall and adjacent flooring in March 1992, and the east and west lower end gate recesses in October 1992, the lock is a good example of 1830s and 1870s lock construction in the West Branch valley. In its dimensions, use of materials, and type of construction, the northern end of the lock is typical of 1830s West Branch system locks. Its burial under fill for several decades does not appear to have damaged the lock to any great extent, at least in that area where the investigations were conducted. The presence of fill has served to protect the lock walls from damage caused by freeze/thaw, and the wooden flooring, the wooden sill, and the various wooden and cast iron fragments retrieved from the lock have been protected from rot due to their submersion in water and/or damp mud for many years. Based on the condition of the uncovered area, it would appear that the remaining sections of the lock--including the additional 1830s construction and the 1870s

extension work--have survived in a similar state. Other locks in the West Branch system survive to this day, some in worse condition than No. 35, others in better condition. Architecturally, the lock remains a significant resource in that it typifies the standard for all locks in the region over a forty-year period. At the same time, it stands out as a unique adaptation of the standard form for a particular situation, requiring an uncommon engineering solution. Physical evidence of this solution, i.e., the use of reversed gates and associated features, has not been discovered during the three excavations at the lock. However, it is believed that such evidence, if still extant, does exist outside of the project area at the upper (south) end of the lock.

The lower end gate recesses and associated gate features discovered during the October 1992 excavations demonstrate common miter gate technology employed on locks throughout the Pennsylvania Canal system. Moreover, with a few minor design exceptions, such as hardware or number of supports or wickets, for example, the overall arrangement is typical of miter gates found all over the world. For two reasons, however, the lock and its features are significant: the fact that the walls survived in such good condition and the fact that so much of the gate pieces and hardware survived. In most cases, canal locks remain open over time, subject to the damaging effects of plant growth and freeze-thaw cycles. Hardware is routinely removed for scrap. In the case of the Bald Eagle Lock, however, at least in the area excavated, the fill within the lock preserved the walls and, for whatever reason, much of the hardware was never removed. The result was a fairly intact example of a lock and miter gate, providing valuable information for research purposes.

IV. SOURCES

A. Architectural Drawings:

Bald Eagle Cross-Cut Canal Lock (West Branch Pennsylvania Canal Lock No. 35), 1833 Historic Site Plan. From Wagner, Dean R., ed. *Historic Lock Haven, An Architectural Survey*. Lock Haven, Pennsylvania: Clinton County Historical Society, 1979, reprinted 1982. ~~Layout by Jill Cremer, Kise Franks & Straw, Inc., Philadelphia, Pennsylvania, 1992~~.

Bald Eagle Cross-Cut Canal Lock (West Branch Pennsylvania Canal Lock No. 35), 1873 Historic Site Plan. Shows alterations planned by Pennsylvania Canal Company. From West Branch Canal Maps, Pennsylvania Canal Company, in possession of Hugh Moore Historical Park and Museums, Easton, Pennsylvania. ~~Layout by Jill Cremer, Kise Franks & Straw, Inc., Philadelphia, Pennsylvania, 1992~~.

"Canal Lock Gate: 1827-1850." Shows detail of typical gate on Delaware and Hudson Canal, New York. From Wakefield, Manville B. *Canal Boats to Tidewater*. Grahamsville, New York: Wakefair Press, 1971, 36. ~~Layout by Jill Cremer, Kise Franks & Straw, Inc., Philadelphia, Pennsylvania, 1992~~.

Regional Site Map (Pennsylvania canal systems). From Shank, William H., P.E. *The Amazing Pennsylvania Canals*. York, Pennsylvania: American Canal and Transportation Center, 1981. ~~Layout by Jill Cremer, Kise Franks & Straw, Inc., Philadelphia, Pennsylvania, 1992~~.

"Typical Lock Gate Assembly, Erie Canal, Little Falls, New York." From *The American Heritage Junior Library History of the Erie Canal.* New York, New York: The American Heritage Company, 1964.

USGS 7.5 Series, Lock Haven and Mill Hall (Pennsylvania) Quads, 1965 (photorevised 1986).

West Branch Pennsylvania Canal, Lock No. 34, 1873 Historic Site Plan. Shows alterations planned by Pennsylvania Canal Company. From West Branch Canal Maps, Pennsylvania Canal Company, in possession of Hugh Moore Historical Park and Museums, Easton, Pennsylvania. ~~Layout by Jill Cremer, Kise Franks & Straw, Inc., Philadelphia, Pennsylvania, 1992.~~

B. Historic Views:

Floyd, J.W.C., photographer. Historic photograph PA-53, Bald Eagle Cross-Cut Canal Lock (West Branch Pennsylvania Canal Lock No. 35), Lock Haven, Pennsylvania, c. 1885, looking north. Original located at the Ross Library, Lock Haven, Pennsylvania.

C. Interviews:

None.

D. Bibliography:

1. Primary and unpublished sources:

Cassel, Clara M. "The West Branch Division of the Pennsylvania Canal." Master's thesis, Bucknell University, 1933.

Cummings, Hubertis M. "State Owned Canals in Pennsylvania." Manuscript, Pennsylvania Historical and Museum Commission, Harrisburg, Pennsylvania. Microfilm, Hugh Moore Historical Park and Museums, Easton, Pennsylvania, n.d.

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2. Secondary and published sources:

The American Heritage Junior Library History of the Erie Canal. New York, New York: The American Heritage Company, 1964.

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Hannegan, Susan B., and Jean Simmons May. *Clinton County: A Journey Through Time.* Lock Haven, Pennsylvania: Clinton County Sesquicentennial, Inc., 1989.

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Shank, William H. *The Amazing Pennsylvania Canals.* York, Pennsylvania: American Canal and Transportation Center, 1981.

_____. *The Amazing Pennsylvania Canals.* York, Pennsylvania: Historical Society of York County, 1965.

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Wakefield, Manville B. *Canal Boats to Tidewater.* Grahamsville, New York: Wakefair Press, 1971.

V. NOTES

[1]William H. Shank, *The Amazing Pennsylvania Canals* (York, Pennsylvania: American Canal and Transportation Center, 1981), 52.

[2]Clara M. Cassel, "The West Branch Division of the Pennsylvania Canal" (unpublished M.A. Thesis, Bucknell University, 1933), 50-51.

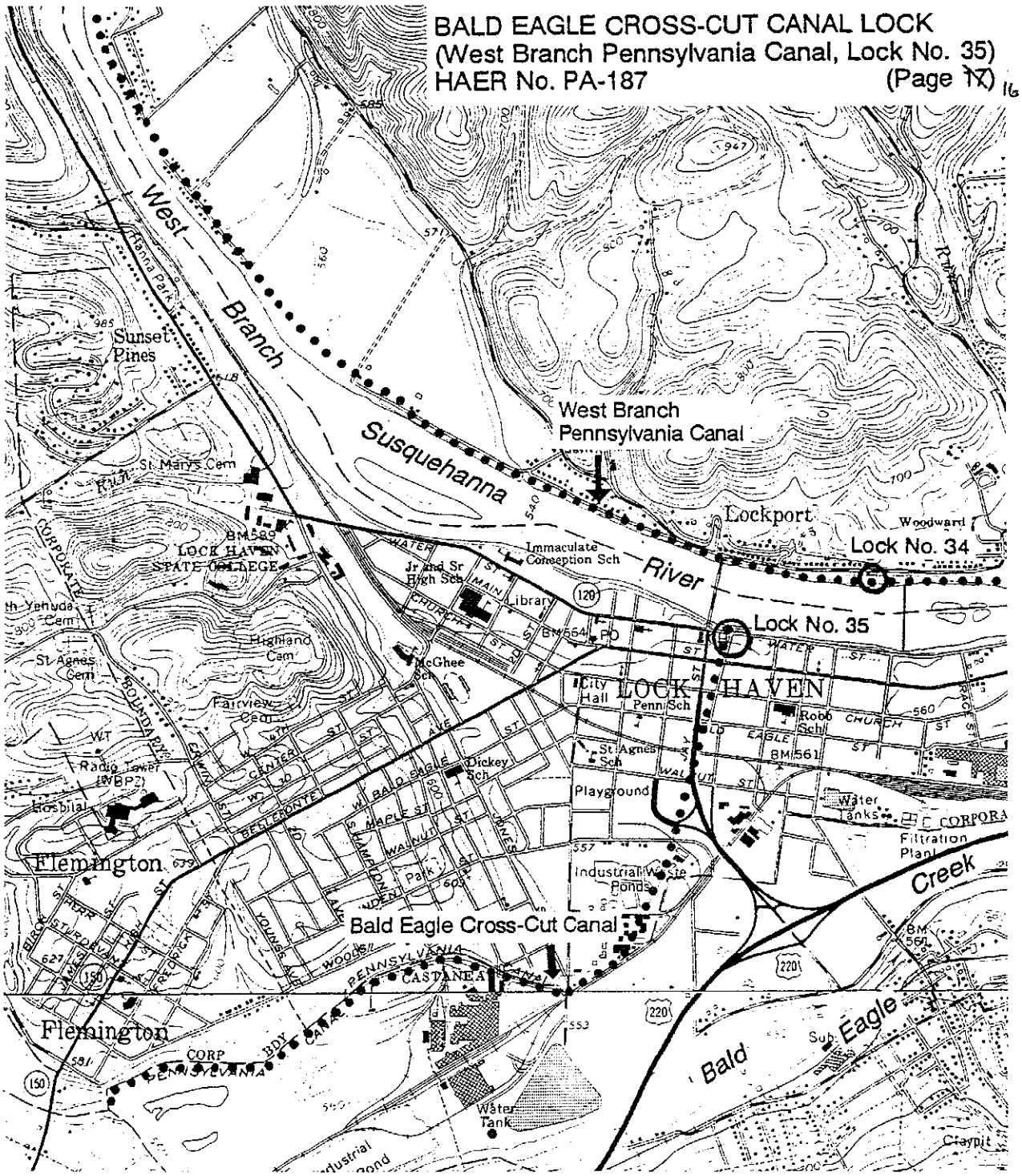
[3]Ibid.

[4]Hubertis M. Cummings, "State Owned Canals in Pennsylvania" (unpublished, undated manuscript on deposit at the archives of the Pennsylvania Historical and Museum Commission at Harrisburg, Pennsylvania, microfilm copy consulted at archives of Hugh Moore Historical Park and Museums, Inc., Easton, Pennsylvania), 12.

[5]Cassel, "The West Branch Division of the Pennsylvania Canal," 50.

[6]Shank, *The Amazing Pennsylvania Canals*, 52.

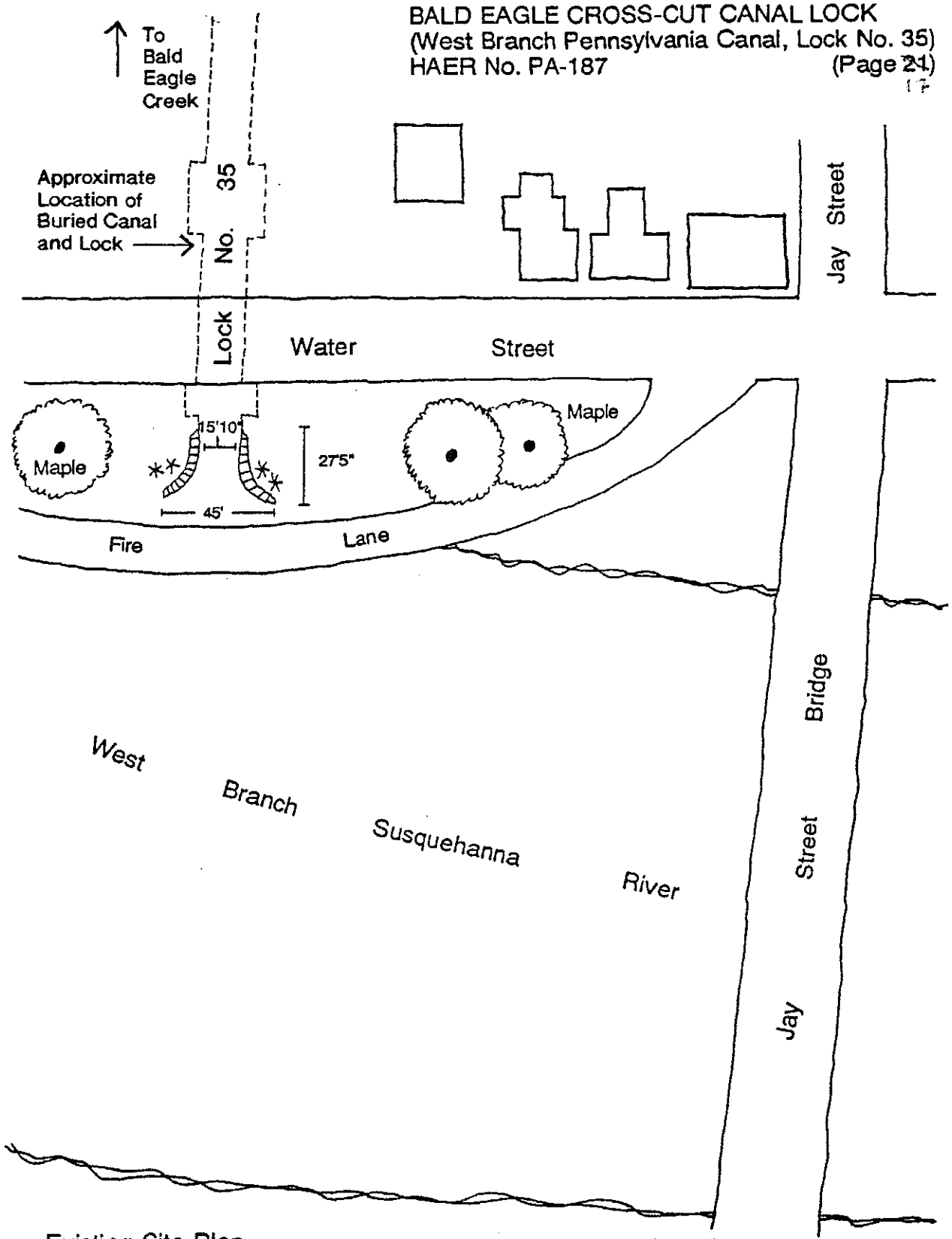
[7]Cassel, "The West Branch Division of the Pennsylvania Canal," 59.
[8]Ibid., 49.
[9]Ibid., 51.
[10]Ibid.
[11]Dr. Ernest Coleman, "Bald Eagle and Spring Creek Navigation," *Canal Currents*, Vol. 19, (Winter, 1972), 5-7. See also David A. Dashiell, Richard Meyer, and Michael Parrington, "Cultural Resources Survey, Lock Haven and Lockport, Clinton County, Pennsylvania," prepared for Baltimore District, U.S. Army Corps of Engineers by John Milner Associates in association with Rogers Golden and Halpern, 1985, 36-38.
[12]Coleman, "Bald Eagle and Spring Creek Navigation," 5-7. See also Dashiell, Meyer and Parrington, "Cultural Resources Survey, Lock Haven and Lockport, Clinton County, Pennsylvania," 36, 47.
[13]Dashiell, Meyer, and Parrington, "Cultural Resources Survey, Lock Haven and Lockport, Clinton County, Pennsylvania," 39-46.
[14]Cassel, "The West Branch Division of the Pennsylvania Canal," 50-52, 57.
[15]Report of James Harris, October 31, 1833, quoted in Dashiell, Meyer and Parrington, "Cultural Resources Survey, Lock Haven and Lock Port, Clinton County, Pennsylvania," 4.
[16]Cassel, "The West Branch Division of the Pennsylvania Canal," 52.
[17]Hubertis M. Cummings, "State owned Canals in Pennsylvania, West Branch Canal Section," 24.
[18]William H. Shank, "Pennsylvania Canal Company 1857-1926," *Canal Currents*, Vol. 73 (Winter, 1986), 3-4. See also, Charles Petrillo, "The Pennsylvania Canal Company (1857-1926): The New Main Line Canal Nanticoke to Columbia," *Canal History and Technology Proceedings*, Vol. VI, 1987, 83-89.
[19]Coleman, "Bald Eagle and Spring Creek Navigation," 6-7.
[20]Susan B. Hannegan, Jean Simmons May, *Clinton County: A Journey Through Time* (Lock Haven, Pennsylvania: Clinton County Sesquicentennial, Inc., 1989), 69.
[21]Shank, "Pennsylvania Canal Company," 4.
[22]Ibid.
[23]Ibid. See also, Cummings, "State Owned Canals in Pennsylvania, West Branch Section," 24-26.
[24]Ibid.
[25]Dashiell, Meyer, Parrington, "Cultural Resources Survey, Lock Haven and Lock Port, Clinton County, Pennsylvania," 50-51.
[26]Ibid.
[27]Hannegan and May, *Clinton County: A Journey Through Time*, 156.



Lock Haven and Vicinity, Showing Approximate Location of Former Canals
Scale: 1 inch = 2000 feet
Layout By: Jill Cremer, 1992

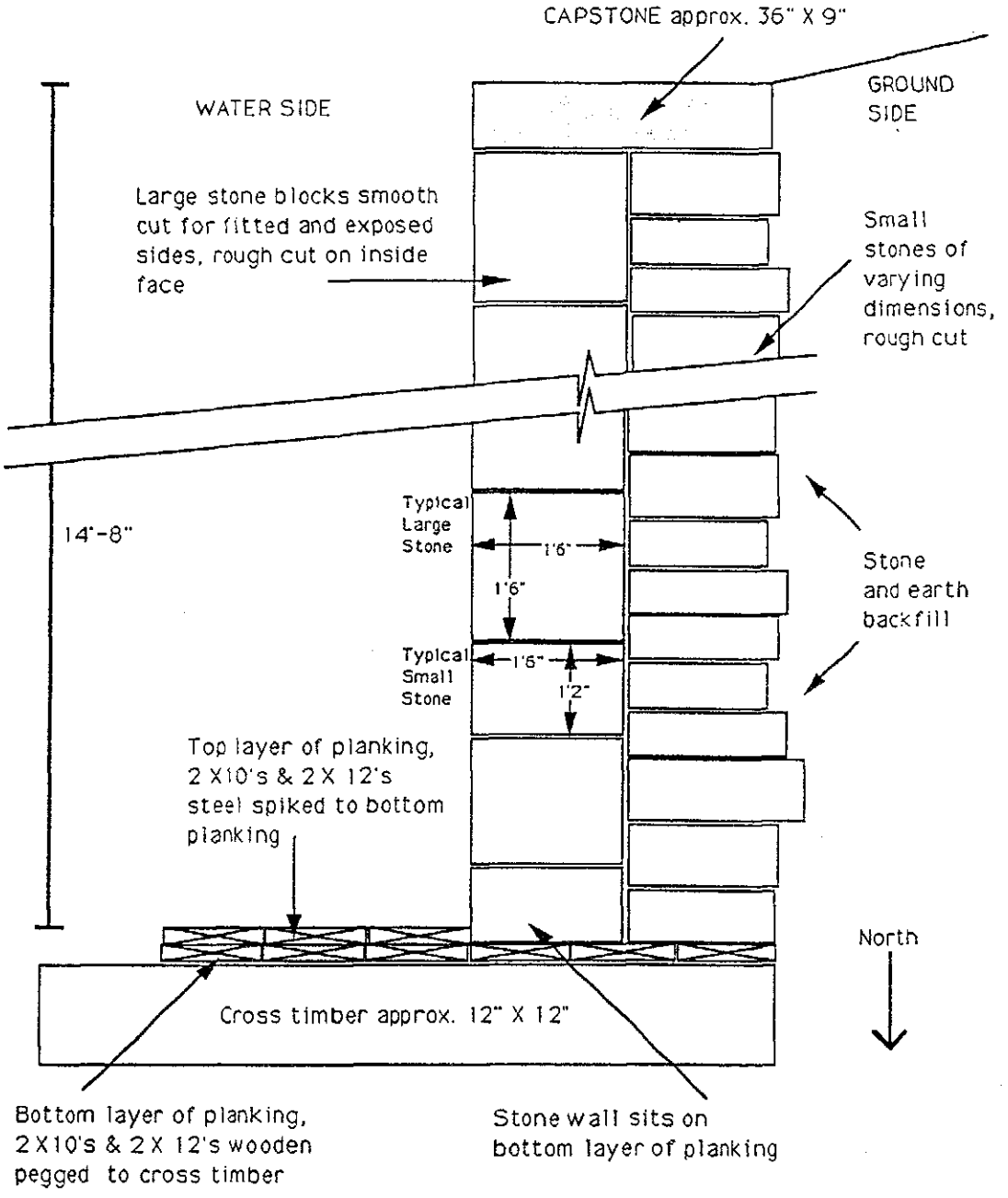
Sources: USGS 7.5 Series, Lock Haven and Mill Hall (Pennsylvania) Quads, 1965 (photorevised 1986); West Branch Canal Maps, Pennsylvania Canal Company, in possession of Hugh Moore Historical Park and Museums, Easton, Pennsylvania; Shank, William H. *The Amazing Pennsylvania Canals*. York, PA: Historical Society of York County, 1965, p. 41.

BALD EAGLE CROSS-CUT CANAL LOCK
(West Branch Pennsylvania Canal, Lock No. 35)
HAER No. PA-187 (Page 21)



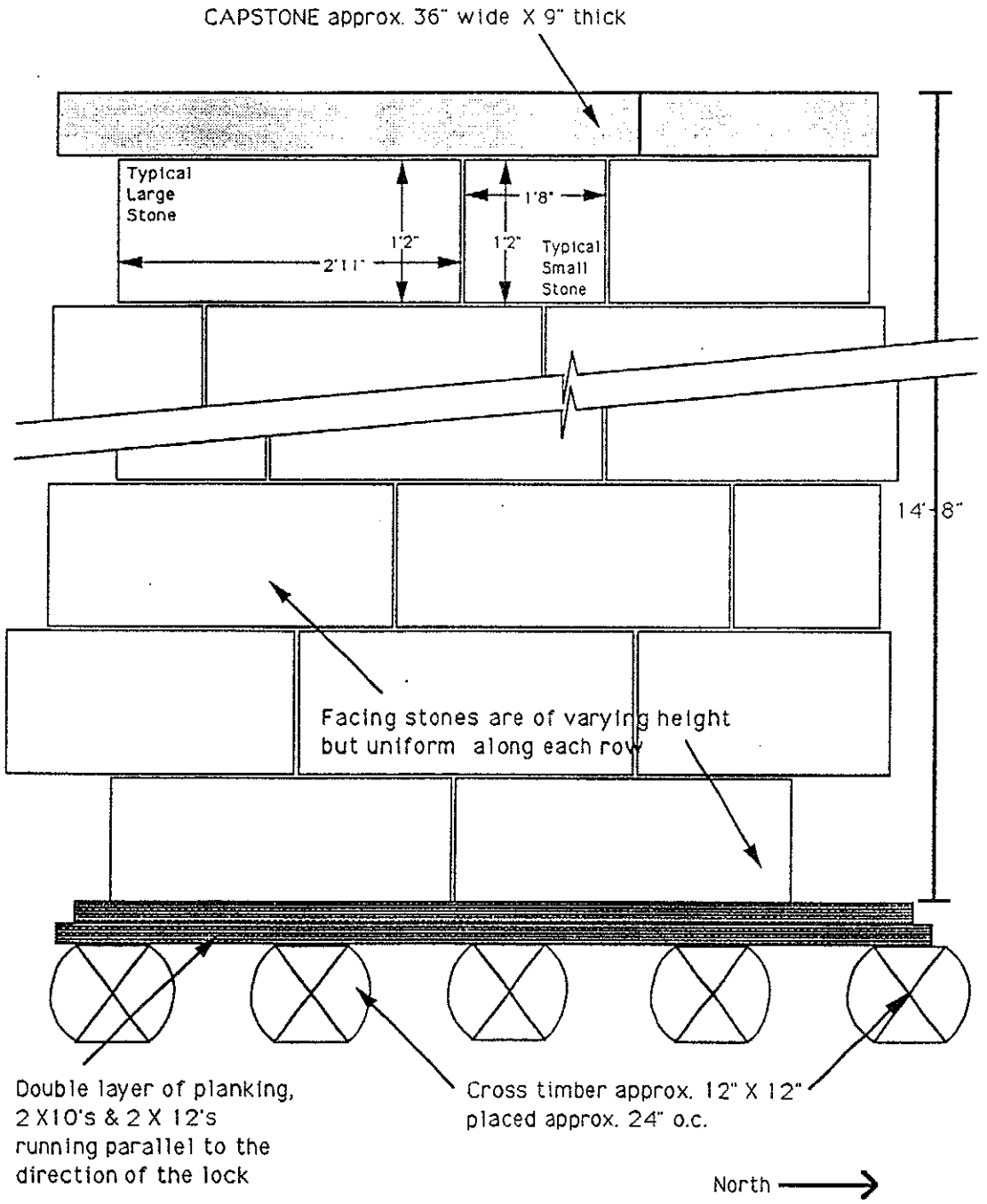
Existing Site Plan
Not to Scale

Date Drawn: 1992
Prepared By: Jill Cremer



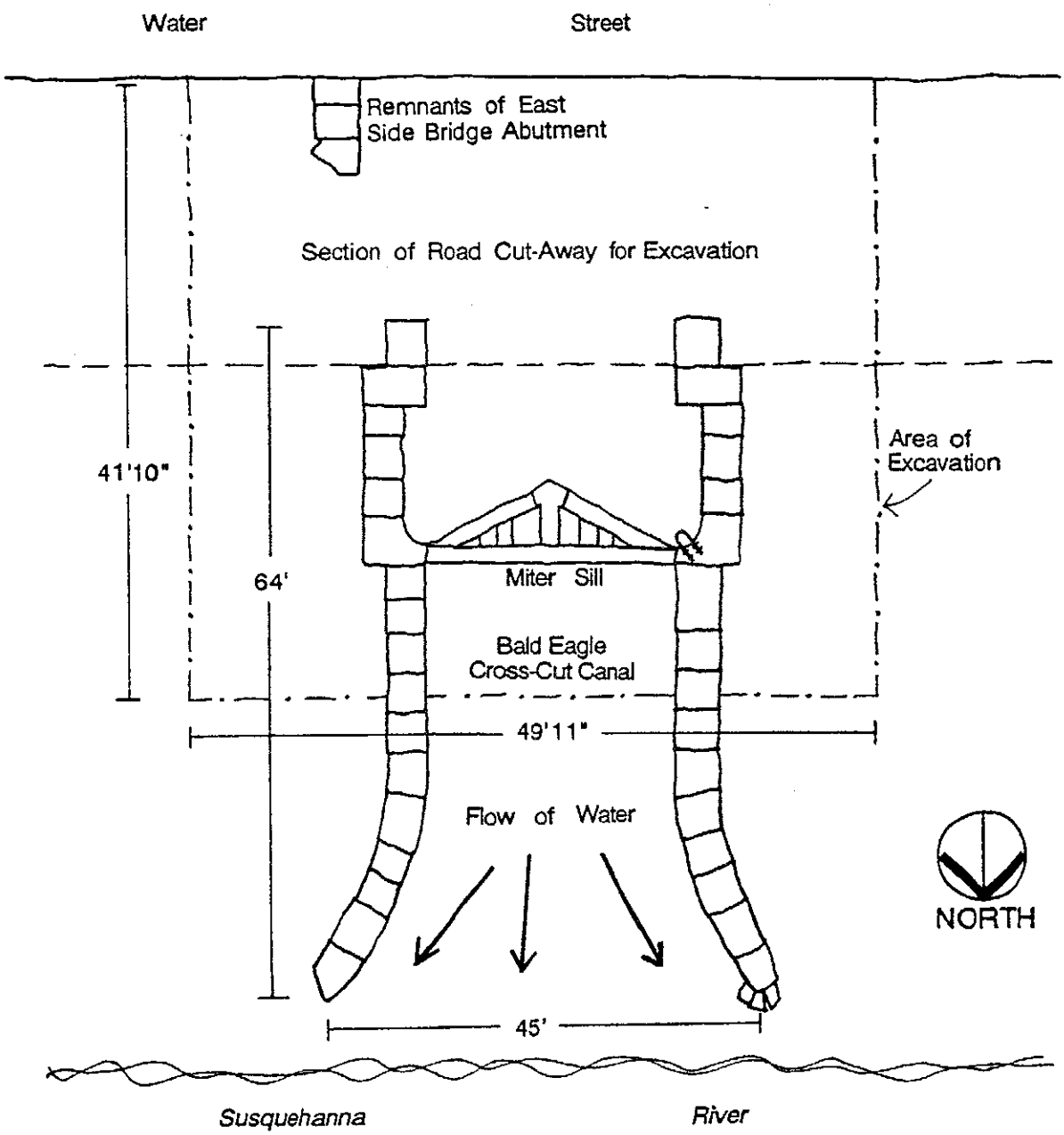
Existing Cross Section of Flooring and West Wall, March 1992
Not to Scale

Date Drawn: 1992
Prepared By: Philip E. Franks and Jill Cremer



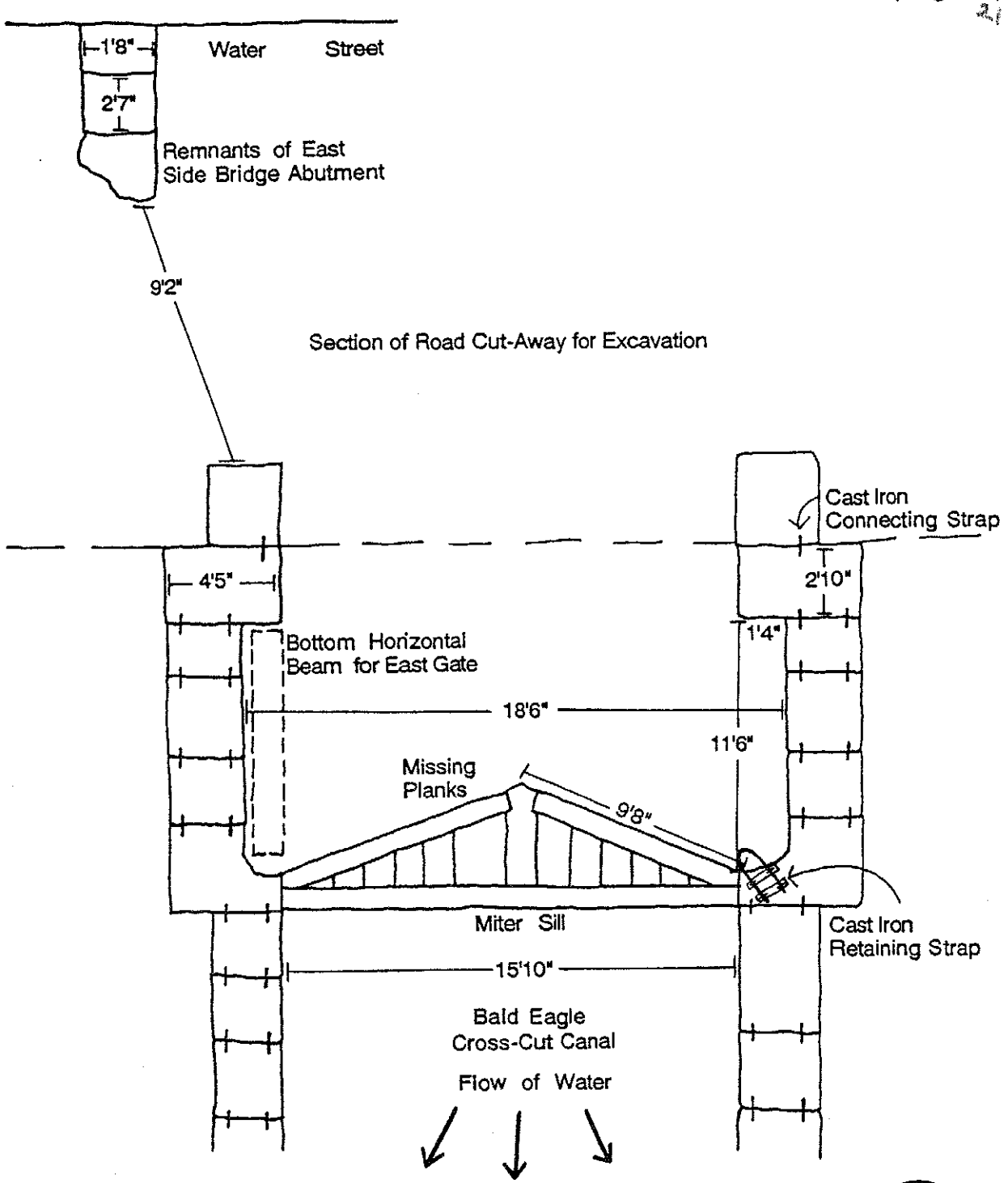
Existing Cross Section of Flooring,
March 1992
Not to Scale

Date Drawn: 1992
Prepared By: Philip E. Franks
and Jill Cremer

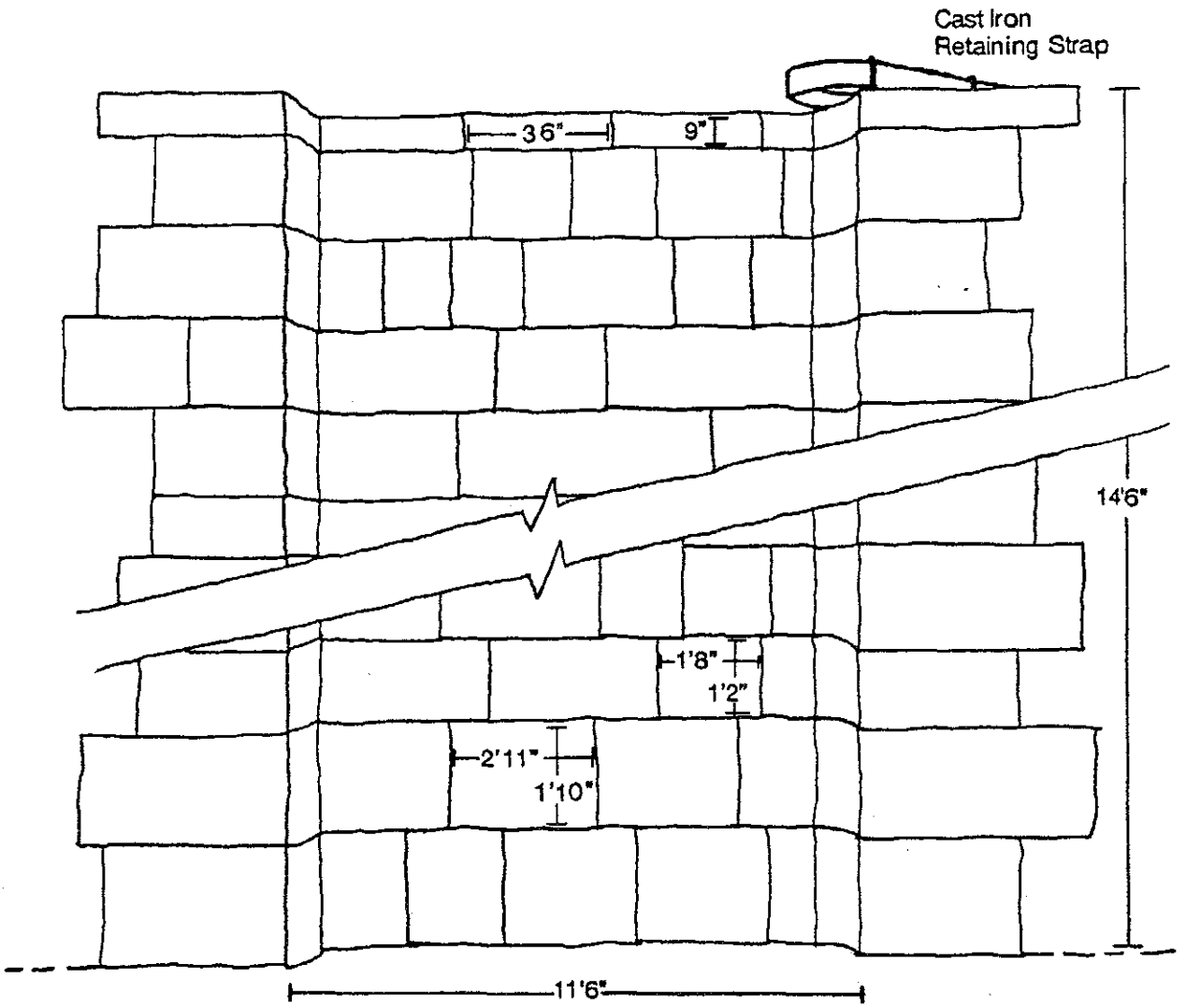


Existing Site Plan, October 1992
Not to Scale
Date Drawn: 1992
Prepared By: Jill Cremer

BALD EAGLE CROSS-CUT CANAL LOCK
(West Branch Pennsylvania Canal, Lock No. 35)
HAER No. PA-187 (Page 25)



Existing Site Plan, October 1992
Detail, Lower End Gate Recess Area
Not to Scale
Date Drawn: 1992
Prepared By: Jill Cremer



Existing Elevation of Lower End West Gate Recess Area, October 1992
Not to Scale
Date Drawn: 1992
Prepared By: Jill Cremer